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ABSTRACT

This study examined possible relationships between the analytic/global dimension of cognitive style, as defined by Davis and Klausmeier (1970) and measured by the Children's Embedded Figures Test (CEFT), and two modes of instruction varying in the level of guidance provided the learner. Sixty Anglo subjects (eight and nine years old), identified as a relatively homogeneous group working at approximately the fourth grade level of ability, were randomly assigned to one of two treatment groups and taught selected concepts of mathematical symmetry for three consecutive days. Instruction was provided by self-paced booklets having either intermediate or maximal guidance. A posttest developed by the investigator was administered on the fourth day to assess initial learning and, again, for retention six weeks later. Results did not indicate significant interaction between the analytic/global dimension of cognitive style and instructional modes varying in the level of guidance. (Author/HMV)

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INDIVIDUAL DIFFERENCES IN COGNITIVE STYLE AND THE GUIDANCE VARIABLE IN INSTRUCTION

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The consideration of individual differences in learners as an important concern in the development and implementation of both curricular and instructional programs and materials is widely accepted. As evidence of this concern, the primary thrust in recent attempts to improve American education has been directed toward some form of individualized instruction.

One area of individual differences which, according to Davis and Klausmeier (1970), seems likely to be influential in learning is that of cognitive style. Cognitive style relates to the cognitive processes and modes of problem solving incorporated by a learner and has been specifically defined by Odom et al. (1971), Kagan et al. (1963), and others. However, in its broadest sense, cognitive style can be thought of as a characteristic mode of processing information.

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Davis and Klausmeier (1970) point out that several different dimensions have been suggested within the confines of the rather general domain of cognitive style. One particular dimension is that concerned with the manner in which individuals respond perceptually to complex stimulus configurations. The two extremes of this dimension, according to Davis and Klausmeier (1970), are

> characterized by subjects who analyze and differentiate the components of the stimulus complex and by subjects who fail to analyze and differentiate the components and respond to the stimulus as a whole (p. 423).

The term "analytic" can be used to describe the former subjects and the term "global" to describe the latter.

This particular dimension of cognitive style has been demonstrated to be an influential factor in performance on a variety of learning tasks and behaviors. Witkin et al. (1962) have conducted research of significance to the study of psychology to suggest that, among other things, more analytic subjects are better able to structure ambiguous stimulus material and are less dependent on external guidance in performance of a task. In addition, results of studies by Long (1962), Guetzkow (1951), Grieve and Davis (1971), and Nelson (1972) have provided evidence to suggest that an analytic cognitive style is preferable to a global one in terms of performance on a variety of learning tasks.

The results of studies mentioned above, along with other research data on cognitive style gathered thus far, suggest that the analytic/global dimension of cognitive style may be particularly influential in learning. Therefore, it seems appropriate to examine its relationship to learning performance in the classroom. Specifically, the research evidence on the analytic/global construct of cognitive style suggests research designed to determine the potential existence of relationships between individual differences in cognitive style and the method used to guide the pupil through an instructional task.

PROBLEM

It was the purpose of the study currently being reported to examine possible relationships between the analytic/global dimension of cognitive style, as defined by Davis and Klausmeier (1970) and measured by the Children's Embedded Figures Test (CEFT) (Karp and Konstadt, 1962), and two modes of instruction varying in the level of guidance (Intermediate and Maximal) provided the learner. Specifically, the study considered the following questions:

> (1) Will global subjects perform better, with respect to initial learning and retention, on an instruction task providing the learner with intermediate guidance or one providing maximal guidance?
>
> (2) Will analytic subjects perform better, with respect to initial learning and retention, on an instructional task providing the learner with intermediate guidance or one providing maximal guidance?
>
> (3) Will analytic subjects perform better, with respect to initial learning and retention, on an instructional task providing the learner with intermediate guidance than global subjects provided the same level of guidance?
>
> (4) Will analytic subjects perform better, with respect to initial learning and retention, on an instructional task providing the learner with maximal guidance than global subjects provided the same level of guidance?

To answer research questions stated above, eight hypotheses were formulated, with respect to the performance of analytic and global subjects on each of two instructional strategies, with initial learning and retention serving as the dependent variables. Figures 1 and 2 provide a succinct illustration of the relationships examined.

Figure 1

SUMMARY OF HYPOTHESES 1-4 TESTED IN INVESTIGATION

Group	Maximal Guidance vs. Intermediate Guidance	
	Initial Learning	Retention
Global	H_1	H_2
Analytic	H_3	H_4

Figure 2

SUMMARY OF HYPOTHESES 5-8 TESTED IN INVESTIGATION

Treatment	Analytic vs. Global	
	Initial Learning	Retention
Intermediate Guidance	H_5	H_6
Maximal Guidance	H_7	H_8

PROCEDURES

Sixty Anglo subjects (eight and nine year olds), identified as a relatively homogeneous group working at approximately the fourth grade level of ability, were randomly assigned to one of two treatment groups and taught selected concepts of mathematical symmetry for three consecutive days.

Instruction was provided by self-paced booklets having either intermediate or maximal guidance. The operational definitions for the two instructional strategies were formulated by combining procedures employed by Bassler et al. (1971) and Worthen (1968) in identifying similar instructional methods. The operational definitions were:

> Intermediate Guidance: An instructional method having (1) a series of questions designed to elicit information that the subject may use to make inferences about the intermediate concepts and final rule to be learned, (2) a statement of the rule to be acquired, and (3) exercises in the application of the learned rule.
>
> Maximal Guidance: An instructional method having (1) a statement of the rule to be acquired, (2) a series of statements and illustrations about the rule and intermediate concepts to be learned, and (3) exercises in the application of the learned rule.

A posttest developed by the investigator was administered on the fourth day to assess initial learning and again for retention six weeks later. The test was designed to evaluate the level of attainment of concepts and generalizations relative to the material on symmetry taught in the self-paced instructional booklets. The test consisted of twenty-five assessment items and included different types of test questions such as multiple choice or the drawing of a certain symmetric figure. Content validity for each of the twenty-five items was obtained.

During the interim between the administration of the posttest for initial learning and retention, the Children's Embedded Figures Test (CEFT) (Karp and Konstadt, 1963) was administered to all subjects for use as a classification variable in identifying subjects within each treatment group as having either an analytic or global cognitive style. This was done by obtaining the distribution of scores on the CEFT for each of the two treatment groups being investigated. The mid-point of those distributions, as identified by their median score, was located for the purpose of dividing each of the two treatment groups into an upper and lower half. The upper half of the continuum was identified as analytic and the lower half global.

RESULTS AND CONCLUSIONS

Each of the eight hypotheses indicated in Figures 1 and 2 was statistically analyzed initially by the Kolmogorov-Smirnov (two-sample) nonparametric test. Further analyses of hypotheses five through eight were conducted using one-way analysis of variance.

Kolmogorov-Smirnov Test for Hypotheses One-Four

The first four hypotheses of the study were concerned with the relative efficacy of two instructional treatments (Intermediate and Maximal Guidance) for subjects characterized as having either analytic or global cognitive styles. Figure 3 provides a report of the Kolmogorov-Smirnov computations for hypotheses one through four.

Figure 3

KOLMOGOROV-SMIRNOV STATISTICS FOR
HYPOTHESES ONE-FOUR

Treatment Groups	N_1	N_2	$\frac{4D^2N_1N_2}{N_1+N_2}$ [a][b]	D [c]	P
Cognitive Style: Analytic					
Intermediate Guidance v. Maximal Guidance initial learning	15	15	1.200	.200	>.05
Intermediate Guidance v. Maximal Guidance retention	15	15	1.200	.200	>.05
Cognitive Style: Global					
Intermediate Guidance v. Maximal Guidance initial learning	15	15	1.200	.200	>.05
Intermediate Guidance v. Maximal Guidance retention	15	15	2.100	.267	>.05

[a] This statistic has approximately a χ^2 distribution with df=2.

[b] chi square statistic of 5.991 required for significance at .05 level with df=2.

[c] D = absolute value of maximum deviation of the distributions.

As indicated in Figure 3, none of the first four hypotheses could be rejected at the .05 level of confidence. These findings suggested the absence of any significant relationship between the independent variable, instructional strategies, and cognitive style.

The conclusion is, that in this particular study, neither an intermediate nor a maximal level of instructional guidance was more facilitative of learning, with respect to either analytic or global subjects. This finding is consistent with those of Grieve and Davis (1971) and Nelson (1972). Neither study found any pervasive statistically significant interaction between the analytic/global dimension of cognitive style and instructional methods.

The absence of significant interactions in H_1-H_4 fails to support the theoretical framework expounded earlier suggesting the possibility of differential performance by subjects with individual differences in cognitive styles on written instructional programs having two contrasting degrees of guidance. It should be noted, however, that certain limitations in the instructional materials, and/or their administration, may have contributed to the findings. These include

> (1) inability of the characteristics utilized to distinguish the two instructional strategies to provide any real degree of differentiation between the two treatments,
>
> (2) an inadequate amount of instructional time (one hour per day for three days); needed to give the materials a chance to effect significant differences between the treatment groups,
>
> (3) an insensitive posttest; perhaps the actual level of concept attainment by the two groups was not adequately distinguished by the posttest measure.

Kolmogorov-Smirnov Test for Hypotheses Five-Eight

The final four hypotheses of the study were concerned with the comparative performance of subjects with an analytic or with a global cognitive style on each of two different instructional treatments. Figure 4 presents a report of the Kolmogorov-Smirnov computations for hypotheses five through eight.

As indicated, the Kolmogorov-Smirnov analyses found analytic subjects performing significantly better on the measure of initial learning for both instructional strategies. However, for retention no significant differences were obtained. Taken alone, these analyses indicate that an analytic cognitive style is preferable to a global one, with respect to initial learning, but not for retention, regardless of the level of instructional guidance. This suggests that analytic subjects may have substantially better short-term memory skills than global subjects. However, for long term memory (six weeks), it appears that differences between analytic and global subjects are decreased.

Further Analysis of Hypotheses Five-Eight Using One-Way ANOVAR

The Kolmogorov-Smirnov test was selected for initial analysis of the data collected in this investigation because (1) it was a non-parametric test useful in comparing two independent samples with small N's, and (2) it was relatively conservative, thus providing reasonable assurance that any statistically significant findings obtained were, indeed, significant. After the analysis of data using the Kolmogorov-Smirnov test was completed, it was observed that, although only two of

Figure 4

KOLMOGOROV-SMIRNOV STATISTICS FOR
HYPOTHESES FIVE-EIGHT

Cognitive Styles	N_1	N_2	$\frac{4D^2N_1N_2}{N_1+N_2}$	D	P
Instructional Strategy: Intermediate Guidance					
Global v. Analytic initial learning	15	15	8.400	.533	<.05
Global v. Analytic retention	15	15	4.800	.400	>.05
Instructional Guidance: Maximal Guidance					
Global v. Analytic initial learning	15	15	6.600	.467	<.05
Global v. Analytic retention	15	15	4.800	.400	>.05

the hypotheses could be rejected at the .05 level, the relatively large D statistics for the other two hypotheses suggested that those comparisons were approaching significance. Therefore, in light of the consideration that the Kolmogorov-Smirnov test is a conservative nonparametric statistical procedure, it was decided by the investigator that additional analysis using a more powerful parametric statistical technique would be appropriate. Consequently, a one-way analysis of variance (ANOVAR) was conducted on the data for hypotheses five through eight. This analysis, along with the Kolmogorov-Smirnov computations, provides a clear depiction of the actual differences between samples being compared in the final four hypotheses.

The results of the statistical testing of hypotheses five through eight using ANOVAR are reported in Figures 5, 6, 7 and 8, respectively.

As reported in the figures, the analyses revealed that each of the final four hypotheses (H_5-H_8) of this study could be rejected at the .05 level of significance.

A considerable amount of research evidence was cited revealing that analytic subjects performed better than global subjects on a variety of learning tasks (Guetskow, 1951; Long, 1962; Grieve and Davis, 1971; Nelson, 1972). It seemed logical to theorize that analytic subjects would perform better than global subjects on an instructional task, regardless of the degree of structure or guidance provided in the task. The ANOVAR statistical findings of this study support that contention.

Figure 5

ANALYSIS OF VARIANCE SOURCE TABLE FOR HYPOTHESIS FIVE

Source	df	MS	F
Analytic-Intermediate v. Global-Intermediate for initial learning	1	218.70	11.88*
Error	28	18.41	

*p less than or equal to .01

Figure 6

ANALYSIS OF VARIANCE SOURCE TABLE FOR HYPOTHESIS SIX

Source	df	MS	F
Analytic-Intermediate v. Global-Intermediate for retention	1	83.33	4.285**
Error	28	19.45	

**p less than or equal to .05

Figure 7

ANALYSIS OF VARIANCE SOURCE TABLE FOR
HYPOTHESIS SEVEN

Source	df	MS	F
Analytic-Maximal v. Global-Maximal for initial learning	1	182.53	6.315**
Error	28	28.90	

**p less than or equal to .05

Figure 8

ANALYSIS OF VARIANCE SOURCE TABLE FOR
HYPOTHESIS EIGHT

Source	df	MS	F
Analytic-Maximal v. Global-Maximal for retention	1	136.53	6.993**
Error	28	22.05	

**p less than or equal to .05

IMPLICATIONS

The present study did not indicate significant interaction between the analytic/global dimension of cognitive style and instructional modes varying in the level of guidance provided the learner. This finding suggests that, perhaps, the degree of structure or guidance in instruction, as defined in this study, is not as important, with respect to cognitive style, as originally contended. It should be noted, however, that cognitive style may interact with instructional modes differentiated by some variable other than guidance or sequence.

This study did obtain rather pervasive findings supporting the contention that an analytic cognitive style is preferable to a global one, in terms of learning performance. This would suggest that agencies and institutions charged with the responsibility of teacher training, both pre-service and in-service, sensitize teachers to individual differences in childrens' cognitive style and their role in accommodating them.

In conclusion, the findings of this study and others suggest considerable variability in the information processing modes of different individuals. These differences in cognitive style may be significant factors in determining the type of individualized instruction programs most beneficial to various students.

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